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REMARKS

Reconsideration and allowance are respectfully requested.

Claims 1-2 and 5-16 are pending in the application.

Claim 13 stands rejected under §112, first paragraph.

Applicant respectfully traverses this rejection. Claim 13 finds direct support in the specification at paragraph [006] (emphasis added):

> According to the present invention, the individual cast wall sections of a gas-turbine combustion chamber are to be joined by laser welding. In particular if the casting material is a highly temperature-resistant nickel-base casting alloy, the low energy input of the laser welding process will enable a crack-free joint to be made between the wall sections in the nickel-base casting materials, with the weld filler metal with inferior thermal strength being dispensable. Weldability free from cracking was demonstrated on the high-strength casting alloy C1023, for example.

For this reason, it is respectfully requested that this rejection be withdrawn.

Attached hereto is a Declaration of one of the coinventors, Karl Schreiber, who has studied the application, pending Office Action and cited references to express his observations on the pending rejections. Mr. Schreiber begins his Declaration but discussing his extensive education and work experience in the area of materials and welding, as well listing his 13 other US patents and patent applications on which he is an inventor or co-inventor. It should be clear from paragraphs 1-5 of his Declaration that Mr. Schreiber is an expert in the field of materials and welding technology. Applicant submits this Declaration in opposition to the pending rejections discussed below.

Claims 1, 2 and 5-16 stand rejected under §112, second paragraph.

Applicant respectfully traverses this rejection. Mr. Schreiber says this at paragraph 7 of his Declaration:

> The Examiner states that the requirement in claim 1 that "the welded joints have a thermo-mechanical strength substantially the same as the individual wall sections" is not supported in the specification. I believe this to

be incorrect. The first page of the specification specifically discusses the inferior thermal strength of a previously known welded combustion chamber (emphasis added): "The rings and dome of the combustion chamber are usually joined by welding, however, the thermal strength of the weld joint is inferior to that of the casting, this circumstance being due to the limited thermal strength of the weld filler material." The specification goes on to state that (emphasis added) "the present invention provides a method enabling larger combustion chambers of gas-turbine engines to be completely manufactured of a casting material, i.e., from wall sections made by a casting process. It is a particular object of the present invention to provide remedy to the above problematics by providing wall sections which are joined together by laser welding to make up the combustion chamber." (p. 2).

The specification goes on (emphasis added) "According to the present invention, the individual cast wall sections of a gas-turbine combustion chamber are to be joined by laser welding. In particular if the casting element is a highly temperature resistant nickel-base casting alloy, the low energy input of the laser welding process will enable a crack-free joint to be made between the wall sections in the nickel-base casting materials. (p. 3) "The method produced by the Specification provides for reduced manufacturing costs and increased thermo-mechanical strength of the combustion chamber". (p. 3)

Thus, since it is specifically stated that "The rings and dome of the combustion chamber are usually joined by welding, however, the thermal strength of the weld joint is inferior to that of the casting, this circumstance being due to the limited thermal strength of the weld filler material" and then "It is a particular object of the present invention to provide remedy to the above problematics", the specification clearly sets forth that the invention provides a weld joint with a thermal strength that is not inferior to that of the casting, or, in other words, "the welded joints have a thermo-mechanical strength substantially the same as the individual wall sections"

The strength of a combustion chamber is only as great as the strength of its weakest part and a weakness of a combustion chamber weld joint because of inferior thermal strength at the weld joint severely threatens the viability of the entire combustion chamber. Therefore, I believe my specification makes clear that my invention creates an improved combustion chamber by, inter alia, eliminating weld joints of inferior strength, which compromise the entire strength of the combustion chamber, and replacing them with welds that do not have inferior strength, but have substantially the same strength as the individual wall sections. While the exact text added to claim 1 is not explicitly stated in the specification, I believe the substance of the text is fully supported by the specification.

For the reasons set forth above in Mr. Schreiber's Declaration, it is respectfully submitted that the specification fully supports the claim 1 phrase "the welded joints have a

thermo-mechanical strength substantially the same as the individual wall sections", even if that exact text is not explicitly stated in the specification, which is not required by the rules. For these reasons, it is respectfully requested that this rejection be withdrawn.

Claims 1-2, 6-9, 11-15 stand rejected under 35 USC § 103(a) as being unpatentable over AAPA in view of Johnson.

Applicant respectfully traverses this rejection.

Claim 1 has been amended slightly to clarify that the plurality of individual wall sections are all cast from the same highly-temperature resistant nickel-based casting alloy.

The Examiner turns to the present specification as teaching the welding of a combustion chamber from different components cast from a highly temperature resistant nickel based casting alloy. Respectfully, this is incorrect.

As Mr. Schreiber makes clear in his Declaration, the specification does not teach or suggest welding different cast components cast from the same highly temperature resistant nickel-based casting alloy to form a combustion chamber. See the Schreiber Dec., at paragraph 6:

> It is very desirable with aircraft turbine engines to have combustion chambers of high strength and low weight. In recent years, much effort has been expended toward reducing fuel consumption, increasing power density and reducing emissions of aircraft turbine engines. This effort has resulted in attempts to develop engine components that are capable of higher temperature operation without a reduction in strength, so that less cooling air need be used to cool components and such air can be used for combustion.
>
> The background section of the subject specification states:
>
> > Gas-turbine combustion chambers are normally made of forged and/or rolled rings which are subsequently machined and suitably drilled. For increased thermal strength, thermal barrier coatings are partly applied to the rings. The dome of the combustion chamber, which is subject to extremely high thermal stress, is in some designs made as a casting in a highly temperature-resistant nickel-base casting alloy. The rings and the dome of the combustion chamber are usually joined by welding, however, the thermal strength of this weld joint is inferior to that of the casting, this circumstance being due to the limited thermal strength of the weld filler material.

> The manufacturing route, i.e. the forging and subsequent machining of the ring and, if applicable, the subsequent welding of the cast dome, incurs an enormous manufacturing effort. Furthermore, the forging materials available are inferior to the precision casting materials available in terms of their thermo-mechanical strength above 1000°C, as a result of which a considerable share of the air compressed in the compressor of the gas-turbine engine is to be used for the cooling of components and is thus not available for combustion. This impairs the power density, the specific fuel consumption and the pollutant-emission characteristics of the gas-turbine engine.

This background text states that (emphasis added) "the dome of the combustion chamber ... is in some designs made as a casting in a highly temperature resistant nickel-base alloy". However, prior to my invention, I am unaware of any combustion chamber of any size where a cast dome of highly temperature resistant nickel-base alloy was welded to a combustion chamber ring cast of the same alloy. Rather, as discussed, this prior art cast dome of highly temperature resistant nickel-base alloy (having the required thermal strength to about 1150° C) could only be welded to a combustion chamber ring made of a forgeable or formable material having a lower thermal strength (to only about 850° C maximum). This ring was not cast, nor was it made of the same alloy as the dome. Further, the weld joint in such a prior art embodiment had to be made outside of hot spot areas of the combustion chamber because of the limited thermal strength of the weld joint. Such a prior art combustion chamber has a lesser thermal strength than my inventive combustion chamber and, as stated in the specification as noted above, required additional cooling air to cool the combustion chamber, at the expense of power density, fuel consumption and polluting emissions.

Thus, contrary to the Examiner's assertion at paragraph 6 of the Office Action, the AAPA does not teach or suggest "that it is known to make a combustion chamber of a gas turbine by 'casting in a highly temperature resistant nickel-base casting alloy' (see paragraph 2 of page 1 of the specification)." Rather, as discussed above, the specification only teaches that a dome of the combustion chamber could be cast of the highly temperature resistant nickel-base casting alloy. The ring of the combustion chamber was not cast from the same alloy as the dome, but was forged from a different formable alloy of inferior thermal strength. Thus, even though such a dome and such a ring were known to be welded, they were of different alloys and only the dome was cast. Further, because the dome and the ring were of different alloys, a filler material was required for such welding, which further degraded the strength of the weld joint. I believe that it was unknown prior to my invention to make a combustion chamber for a gas turbine engine where at least two components of the combustion chamber were both cast from the same highly temperature resistant nickel-based casting alloy and then welded together such

> that the welded joints have a thermo-mechanical strength substantially the same as the individual components, i.e., the welded joints do not have an inferior thermo-mechanical strength as compared to the welded components.

Thus, the specification only teaches that a dome of the combustion chamber could be cast of the highly temperature resistant nickel-base casting alloy. The ring of the combustion chamber was not cast from the same alloy as the dome, but was forged from a different formable alloy of inferior thermal strength. This was so because prior to the present invention, it was unknown how to weld two together two pieces cast from the same highly temperature resistant nickel-base casting alloy. Therefore, the cast dome of highly temperature resistant nickel-base casting alloy could only be welded to a forged/formed ring made from a formable alloy of inferior thermal strength. Further, because the dome and the ring were of different alloys, a filler material was required for such welding, which further degraded the strength of the weld joint.

None of the cited references (AAPA, Johnson or Gasse) teach or suggest welding together a plurality of cast components of the same highly-temperature resistant nickel-based casting alloy, nor do they teach or suggest that the welded joints of such a welded assembly have a thermo-mechanical strength substantially the same as the individual components themselves. See Schreiber Declaration, paragraph 10.

Claim 1 specifically requires:

> casting a plurality of individual wall sections from a same highly-temperature resistant nickel-based casting alloy;
> joining the individual wall sections by laser welding to make up the combustion chamber;
> wherein the welded joints have a thermo-mechanical strength substantially the same as the individual wall sections.

Since none of the cited references teach or suggest welding together a plurality of cast components cast of the same highly-temperature resistant nickel-based casting alloy, **this rejection must fail for this reason alone** because the cited references do not teach or suggest all of the required elements of claim 1.

For this reason alone, it is respectfully submitted that this rejection should be withdrawn and Applicant respectfully requests that this rejection be withdrawn.

Further, Johnson does not cure this deficiency: See the Schreiber Declaration at paragraph 8:

> I have reviewed Johnson, US Patent 5,430,346. Johnson is directed to the laser welding of spark plugs. While such spark plugs are exposed to high temperatures, they do not endure the high mechanical stress that a gas turbine combustion chamber does. Significantly, these spark plugs are relatively small in size and the welded components of the spark plugs are even smaller. These small components do not encounter the residual stresses that occur in welding large components such as the combustion chamber components of the claimed invention. The bigger the components welded, the greater the residual stresses that occur under conventional welding. The residual stresses that occur under conventional welding of large components, such as the combustion chamber components of the present invention, weaken the welded assembly and can result in catastrophic failure of the combustion chamber.
>
> The claimed method provides a welding method whereby such large cast components can be welded together without creating the residual stresses found in a conventionally welded combustion chamber, and this results in a stronger, more reliable combustion chamber having a significantly less chance of failure. Therefore, the welding of the small components of a spark plug is simply incomparable to the welding of the large parts of a gas-turbine engine combustion chamber and the mechanical failure of such a spark plug, while undesirable, is substantially less significant than the mechanical failure of a combustion chamber of a gas turbine typically used in an aircraft. Therefore, it is my belief that a person of ordinary skill in the field of gas turbine combustion chamber design/manufacturing would not look to the disclosure of Johnson, relating to manufacturing spark plugs, to solve a problem in manufacturing combustion chambers for gas turbine engines.
>
> Further, nowhere does Johnson teach or discuss laser welding together a plurality of cast individual sections, all of a highly-temperature resistant nickel-based casting alloy. Johnson only teaches the laser welding of a precious metal alloy insert (of platinum, platinum and iridium alloy or other alloy of platinum, or palladium, iridium or an alloy thereof) to a ground electrode 12B or a center electrode 18B of a nickel alloy. See Johnson, col. 5, line 51 through col. 6, line 14. Johnson also teaches the welding of the ground electrode of a nickel alloy to the spark plug skirt 26 of metal shell 20 of conventional structure. See Johnson, col. 5, lines 41-45, col.3, line 66 through col. 4, line 2 and col. 4, lines 42-50. Johnson only teaches laser welding of one component of nickel alloy to another component of another, non-nickel alloy. Such welding would require a filler material because of the different alloys being welded. Nowhere does Johnson teach or suggest that one component of highly-temperature resistant

nickel-based *casting* alloy be laser welded to another component of highly-temperature resistant nickel-based *casting* alloy.

Furthermore, as discussed above, neither the precious metal inserts welded to the ground electrode 12B or the center electrode 18B, nor the ground electrode 12B welded to the metal shell 20, encounter the extreme mechanical stresses that are encountered by the combustion chamber wall sections and the joints therebetween of the invention of claim 1.

Finally, nowhere does Johnson disclose or suggest a component formed from a plurality of laser welded wall sections of a highly-temperature resistant nickel-based casting alloy where the welded joints have a thermo-mechanical strength substantially the same as the individual wall sections. Johnson never even addresses the strength of the welded joint, whether laser welded or not. This is not surprising to me because of the less critical nature of the strength of the weld joint in Johnson's spark plug, as compared to the combustion chamber of the claimed invention.

I do not see any disclosure or suggestion in the cited prior art of manufacturing a combustion chamber formed from a plurality of laser welded wall sections of a highly-temperature resistant nickel-based casting alloy where the welded joints have a thermo-mechanical strength substantially the same as the individual wall sections. The prior art method discussed in my specification teaches away from such a method and Johnson, even if applicable and combinable with such prior art, which I believe it is not, as discussed above, is simply silent on the subject.

Therefore, for the reasons set forth above in Mr. Schreiber's Declaration, a person of ordinary skill in the art would not turn to Johnson to cure the deficiencies disclosed in the AAPA, and even if he or she did, Johnson would fail to cure the deficiencies of the AAPA.

See also, Schreiber Declaration, paragraph 11:

Based on my experience, qualifications, and the prior art of record and for reasons stated herein, it is my opinion that my inventive method would not have been obviousness to a person having ordinary skill in the art at the time the referenced application was filed, based on the cited references of record. It is also my firm belief that the method claimed in the subject application, at the time of filing thereof, was not known, or even attempted or reduced to practice by persons of ordinary skill in the art and thus would not have been obvious.

For these reasons, it is respectfully requested that this rejection be withdrawn.

Claims 2 and 5-16 all ultimately depend from claim 1 and are allowable for the reasons given above with respect to claim 1 and for the further limitations contained therein.

Claims 5, 10 and 16 stand rejected under 35 USC § 103(a) as being unpatentable over AAPA in view of Johnson and further in view of Gasse.

Applicant respectfully traverses this rejection. Mr. Schreiber says this at paragraph 9 of his Declaration:

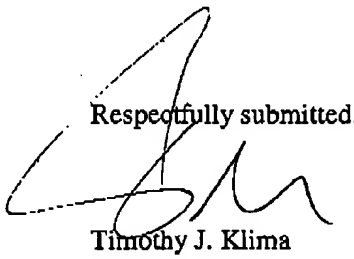
> With respect to the Gasse reference, the Examiner states at paragraph 12 that she is merely using Gasse "to show the teaching that the concept of joining technique by laser welding using with or without filler metal/material is an old and well known concept used throughout the art of welding." Gasse discloses this in his background section and the rest of Gasse is completely irrelevant as he teaches an invention for brazing ceramic components. Gasse does not teach or suggest anything about the welding of components of a highly-temperature resistant nickel-based casting alloy. I believe that a person of ordinary skill in the art fully aware of the problems of joining components of a highly-temperature resistant nickel-based casting alloy would not look to Gasse to solve such problems because Gasse has nothing whatsoever to do or say about joining such nickel-based casting alloys either in discussing the prior art or teaching his invention. A statement that welding without filler is known is not a teaching that such an approach can be used in any type of welding process of any type of metal alloy.
>
> While welding without a filler is known, I can find no teaching or suggestion in Gasse or the other cited art that would lead a person of ordinary skill in the art to combine Gasse as the Examiner has done to suggest laser welding without a filler of a plurality of wall sections cast of the same highly-temperature resistant nickel-based casting alloy where the welded joints have a thermo-mechanical strength substantially the same as the individual wall sections. I do not believe a person of ordinary skill in the art would look to Gasse to solve the deficiencies of the AAPA and Johnson with respect to claims 5, 10 and 16.
>
> Even though Gasse discloses or suggests nothing about joining highly-temperature resistant nickel-based casting alloys, welding the individual wall sections without filler material is an important aspect of the claimed invention. By laser welding the individual wall sections without filler material, an inferior thermal strength of the filler material cannot jeopardize the strength of the weld. This results in a stronger weld and a stronger combustion chamber. Since Gasse has nothing to say about joining highly-temperature resistant nickel-based casting alloys, Gasse fails to even recognize the problems that are incurred in welding such highly temperature resistant alloys. For this further reason, I do not believe a person of ordinary skill in the art would look to Gasse to solve the deficiencies of the AAPA and Johnson with respect to claims 5, 10 and 16.

Therefore, as set forth above in Mr. Schreiber's Declaration, there is no teaching or suggestion in Gasse or the other cited art that would lead a person of ordinary skill in the art to combine Gasse as the Examiner has done to suggest laser welding without a filler of a plurality of wall sections cast of the same highly-temperature resistant nickel-based casting alloy where the welded joints have a thermo-mechanical strength substantially the same as the individual wall sections. Since neither Johnson nor Gasse has nothing to say about welding cast pieces cast from the same highly-temperature resistant nickel-based casting alloys together, neither reference even recognizes the problems that are incurred in welding such highly temperature resistant alloys, and neither reference cures the deficiencies of the AAPA with respect to claims 5, 10 and 16. Thus, a person of ordinary skill in the art would not turn to Gasse to cure the deficiencies of the AAPA & Johnson with respect to claims 5, 10 and 16, and even if he or she did, Gasse would not cure the deficiencies of the AAPA & Johnson.

For these reasons, it is respectfully requested that this rejection be withdrawn.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance, and such a Notice is earnestly solicited. If any points remain in issue, the Examiner is requested to telephone the undersigned at the number below.

Respectfully submitted,



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